

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A patient positioning device for positioning a couch supporting a patient to which a charged particle beam is irradiated from a particle beam irradiation system, said patient positioning device comprising:

~~an X-ray emission device mounted to said particle beam irradiation system, being movable between a first position located in a path of said charged particle beam and a second position located away from the path of said charged particle beam to be out of interference with advance of said charged particle beam, and emitting an X-ray in said first position~~ for emitting an X-ray;

an X-ray entry device for receiving the X-ray emitted from said X-ray emission device and outputting an output signal depending on the received X-ray;

an image information generator for generating second image information regarding a portion of the patient lying across the path of said particle beam by using the output signal outputted from said X-ray entry device; and

a processing unit for executing pattern matching between a ~~part of first~~ first image information in a first set area including an isocenter, the first image information representing a tumor in the body of the patient ~~and serving as a reference including the isocenter, and a part of the,~~ and said second image information in a second set area including a position corresponding to the path of said charged particle beam, thereby producing information used for positioning of said couch.

2. (Original) A patient positioning device according to Claim 1, further comprising a couch controller for controlling movement of said couch in accordance with said positioning information.

3. (Original) A patient positioning device according to Claim 1, wherein said processing unit executes the pattern matching by using information of a plurality of pixels contained in the first image information in said first set area and information of a plurality of pixels contained in the second image information in said second set area.

4. (Original) A patient positioning device according to Claim 3, wherein said processing unit produces said positioning information based on the least square method such that a deviation between the information of a plurality of pixels contained in the first image information in said first set area and the information of a plurality of pixels contained in the second image information in said second set area is minimized.

5. (Currently Amended) A patient positioning device for positioning a couch supporting a patient to which a charged particle beam is irradiated from a particle beam irradiation system, said patient positioning device comprising:

~~an X-ray emission device mounted to said particle beam irradiation system, being movable between a first position located in a path of said charged particle beam and a second position located away from the path of said charged particle beam to be out of interference with advance of said charged particle beam, and emitting an X-ray in said first position;~~

an image information generator for generating second image information regarding a portion of the patient lying across the path of said charged particle beam by using a signal depending on the X-ray emitted from said X-ray emission device;

a display unit for displaying first image information representing a tumor in the body of the patient and serving as a reference including the isocenter, and the second image information; and

a processing unit for setting a first set area including the isocenter with respect to the first image information, setting a second set area including a position corresponding to the path of said charged particle beam with respect to the second image information, executing pattern matching between the first image information in said first set area and the second image information in said second set area, producing information used for positioning of said couch, and outputting information for displaying respective frames of said first set area and said second set area to said display unit.

6. (Original) A patient positioning device according to Claim 5, wherein said display unit comprises a first display unit for displaying the first image information and a

second display unit for displaying the second image information, said second display unit being separate from said first display unit.

7. (Original) A patient positioning device according to Claim 5, wherein said image information generator comprises an X-ray transducer for converting the incident X-ray into light, and a camera for capturing the light and producing the second image information.

8. (Original) A patient positioning device according to Claim 5, wherein said image information generator comprises a plurality of semiconductor radiation detectors for converting the incident X-ray into electrical signals, a plurality of signal processors disposed in a one-to-one relation to said semiconductor radiation detectors and processing said electrical signals, and an image information producing unit for receiving outputs from said signal processors and producing the second image information.

9. (Original) A patient positioning device according to Claim 5, wherein said processing unit executes the pattern matching by using information of a plurality of pixels contained in the first image information in said first set area and information of a plurality of pixels contained in the second image information in said second set area.

10. (Original) A patient positioning device according to Claim 9, wherein said processing unit produces said positioning information based on the least square method such that a deviation between the information of a plurality of pixels contained in the first image information in said first set area and the information of a plurality of pixels contained in the second image information in said second set area is minimized.

11. (Currently Amended) A patient positioning device for positioning a couch supporting a patient to which a charged particle beam is irradiated from a particle beam irradiation system, said patient positioning device comprising:

~~an X-ray emission device mounted to said particle beam irradiation system, being movable between a first position located in a path of said charged particle beam and a second position located away from the path of said charged particle beam to be out of interference with advance of said charged particle beam, and emitting an X-ray in said first position;~~

an image information generator for generating second image information regarding a portion of the patient lying across the path of said charged particle beam by using a signal depending on the X-ray emitted from said X-ray emission device; and

a processing unit for setting a first set area including an isocenter with respect to first image information representing a tumor in the body of the patient and serving as a reference including the isocenter, setting, with respect to the second image information, a second set area having substantially the same size as said first set area and including a position corresponding to the path of said charged particle beam, executing primary pattern matching between the first image information in said first set area and the second image information in said second set area to determine a primary matching area with respect to the second image information, and executing secondary pattern matching between the first image information in said first set area and the second image information in said primary matching area, thereby producing information used for positioning of said couch.

12. (Original) A patient positioning device according to Claim 11, further comprising a couch controller for controlling movement of said couch in accordance with said positioning information.

13. (Original) A patient positioning device according to Claim 11, wherein said processing unit executes the pattern matching by using information of a plurality of pixels contained in the first image information in said first set area and information of a plurality of pixels contained in the second image information in said second set area.

14. (Original) A patient positioning device according to Claim 13, wherein said processing unit produces said positioning information based on the least square method such that a deviation between the information of a plurality of pixels contained in the first image information in said first set area and the information of a plurality of pixels contained in the second image information in said second set area is minimized.

15. (Original) A patient positioning device according to Claim 11, further comprising a display unit for displaying the first image information at least in said first set area and the second image information at least in said second set area,

wherein said processing unit outputs the information for displaying respective frames of said first set area and said second set area to said display unit.

16. (Original) A patient positioning device according to Claim 11, wherein said display unit comprises a first display unit for displaying the first image information and a second display unit for displaying the second image information, said second display unit being separate from said first display unit.

17. (Currently Amended) A patient positioning method for positioning a couch supporting a patient to which a charged particle beam is irradiated from a particle beam irradiation system, said patient positioning method comprising the steps of:

~~moving an X-ray emission device for emitting an X-ray to be located in a path of said charged particle beam;~~

~~irradiating the X-ray emitted from said X-ray emission device to a tumor in the body of the patient on said couch along the path of said charged particle beam;~~

generating, based on the X-ray having penetrated a portion of the patient lying across the path of said charged particle beam, second image information regarding the portion of the patient;

taking, into a processing unit, first image information representing the tumor in the body of the patient and serving as a reference including the isocenter;

taking second image information into said processing unit;

executing, by utilizing said processing unit, pattern matching between a part of the first image information in a first set area including the isocenter and a part of the second image information in a second set area including a position corresponding to the path of said charged particle beam, thereby producing information used for positioning of said couch.

18. (Currently Amended) A patient positioning method for positioning a couch supporting a patient to which a charged particle beam is irradiated from a particle beam irradiation system, said patient positioning method comprising the steps of:

~~moving an X-ray emission device for emitting an X-ray to be located in a path of said charged particle beam;~~

~~irradiating the X-ray emitted from said X-ray emission device to a tumor in the body of the patient on said couch along the path of said charged particle beam;~~

generating, based on the X-ray having penetrated a portion of the patient lying across the path of said charged particle beam, second image information regarding the portion of the patient;

setting a first set area including an isocenter with respect to first image information representing the tumor in the body of the patient and serving as a reference including the isocenter;

setting, with respect to the second image information, a second set area having substantially the same size as said first set area and including a position corresponding to the path of said charged particle beam;

executing primary pattern matching between the first image information in said first set area and the second image information in said second set area to determine a primary matching area with respect to the second image information; and

executing secondary pattern matching between the first image information in said first set area and the second image information in said primary pattern matching area, thereby producing information used for positioning of said couch.

19. (New) A patient positioning device according to Claim 1, wherein said X-ray emission device is mounted to said particle beam irradiation system and movable between a first position located in a path of said charged particle beam and a second position located away from the path of said charged particle beam to be out of interference with advance of said charged particle beam, and configured to emit an X-ray in said first position.

20. (New) A particle beam treatment system comprising:

- a particle beam generator;
- a particle beam irradiation system for irradiating a charged particle beam supplied by said particle beam generator to a tumor of a patient;
- a couch for supporting said patient;
- a patient positioning device comprising an X-ray emission device for emitting an X-ray, an X-ray entry device for receiving the X-ray emitted from said X-ray emission device and outputting an output signal depending on the received X-ray, an image information generator for generating second image information regarding a portion of the patient lying across the path of said particle beam by using the output signal outputted from said X-ray entry device, and a processing unit for executing pattern matching between a first image information in a first set area including an isocenter, the first image information representing a tumor in the body of the patient, and said second image information in a second set area including a position corresponding to the path of said charged particle beam thereby producing information used for positioning of said couch;
- a couch controller for controlling movement of said couch in accordance with said positioning information; and
- a couch driver for moving said couch based on said couch controller.